Microsoft

Cortana Analytics: Prescription For Healthcare

Executive Summary

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he healthcare industry is facing enormous challenges as it struggles to comply with the Affordable Care Act and shift from a volume-based care-delivery system to one that is value-driven. Advanced analytics can be indispensable to decision-makers tasked with guiding their organizations in the months and years ahead. It provides prediction, prescription, and automation capabilities that can help healthcare organizations improve efficiencies, better manage patient care, and reduce costs.

The Microsoft Cortana Analytics Suite offers the foundation healthcare organizations need at this time of sweeping change. Not only is this cloud-based platform scalable, flexible, cost effective, secure, and optimized for rapid application development, it is designed to manage structured and unstructured data from multiple sources. This unique capability makes developing predictive analytics solutions far less costly and time-consuming.

In a healthcare organization, essential data can come from a wide range of sources including electronic health records, environmental and socioeconomic reports, genomics, clinical data, and other sources. Once the data is organized, machine-learning algorithms find patterns in the data. The patterns can then be used to construct models that can predict medical events, trends, or risks.

This new technology improves detection of fraud and waste as well, cutting costs for both patient and provider. Another way it cuts costs is via multi-sourced data models that enable return prediction. With this capability, hospitals can better understand the causes of readmissions, reduce them, and avoid the penalties Medicare levies on healthcare providers with high readmission rates.

Several innovative healthcare organizations are already using Big Data to improve patient outcomes. Care Innovations, a GE/Intel company, has developed a program that improves the quality of life for seniors by charting their health status remotely. This solution takes advantage of new sensor technology that makes it possible to monitor patients in the comfort of their own home.

England's Wellcome Trust has accelerated its work in genetics by using the cloud.

Success in the changing healthcare industry requires creating a data-driven organization for both high-quality patient care and operational effectiveness.

The Carolinas Healthcare System is improving patient care with advanced analytics by identifying patients who are at high risk of readmission. As a side benefit, all three of these companies have reduced operating costs.

In the future, healthcare organizations will contend with population health programs. Instead of being compensated on a patient-by-patient basis, providers will be paid based on the health of the community. Big Data and advanced analytics will continue to be essential tools for healthcare organizations and providers as compensation shifts to this new model.

Healthcare Trends

Advanced analytics is an essential tool

Every year in the U.S. nearly $4 trillion is spent on healthcare.[1] Of that amount, more than 75 percent is spent on managing chronic conditions.[2] Americans are feeling the pain, physically and financially. According to Harvard researchers, 62 percent of all personal bankruptcies filed in the U.S. in 2007 were the result of exorbitant medical bills.[3] The solution is better preventive medicine and earlier, more effective detection and treatment of cancer, as well as chronic conditions, such as diabetes, cardiovascular disease, lung disease, and obesity.

Government is stepping in, with policy changes in Medicare/Medicaid and an assortment of new regulations. Private payers are following suit. The objective is to promote value that results in better patient outcomes, rather than numbers of services performed. Accordingly, healthcare organizations are being subject to both incentives and penalties that prompt cost control, reduce uneven care results, and improve overall health.

Yet another challenge comes from an expanding population that draws heavily on the healthcare system and the crush of Baby Boomers who will soon be or are already enrolled in Medicare. At the same time, insurers are cutting payments and moving towards outcome-based models. While payers have used fixed-priced models for procedures such as hip replacements for years, there is a new trend emerging. Instead of paying a fixed price just for the procedures, some payers are now bundling post-discharge care into the compensation package.
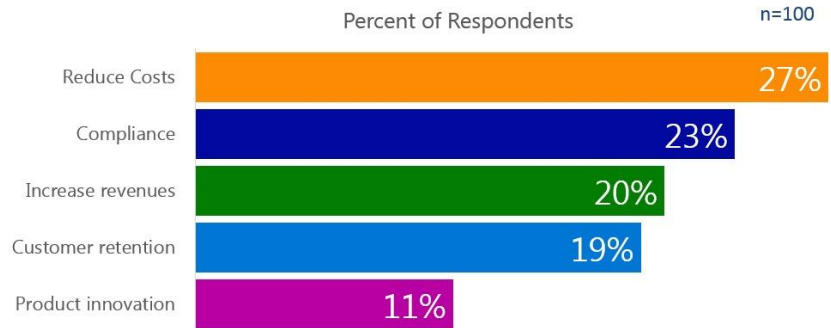
Microsoft recently surveyed a hundred U.S. healthcare executives to discern which issues they'd identify as crucial to their organizational success. Half the executives were from organizations with up to 10,000 employees. The remaining organizations were almost as large. The executives rated cutting costs and regulatory compliance as their highest priorities (with the assumption that quality of care is a given). Vying for third place were increasing revenue and customer retention.

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[1] Dan Munro, Forbes, Annual U.S. Healthcare Spending Hits $3.8 Trillion, 2 February 2014.
[2] Anderson G. Chronic conditions: making the case for ongoing care. Baltimore, MD: John Hopkins University; 2004.
[3] http://www.businessweek.com/bwdaily/dnflash/content/jun2009/db2009064_666715.htm

Top Healthcare Business Priority

Percent of Respondents   n=100

Priority	Percent
Reduce Costs	27%
Compliance	23%
Increase revenues	20%
Customer retention	19%
Product innovation	11%

Advanced analytics can be the fulcrum for balancing quality care, regulatory compliance and profitability.

A healthcare partner for a new era

Microsoft has created a portfolio of cloud-based services designed to provide the healthcare industry, and other fields, with a rapid, low-cost development platform for leveraging Big Data and advanced analytics. The Microsoft Cortana Analytics Suite can receive, process, and store vast quantities of rapidly changing structured and unstructured data. Once the data is in the proper format, advanced analytics can be used to find patterns. Patterns can be converted into models with predictive power. When new data is put through the model, future events can be predicted to improve decision-making and planning.
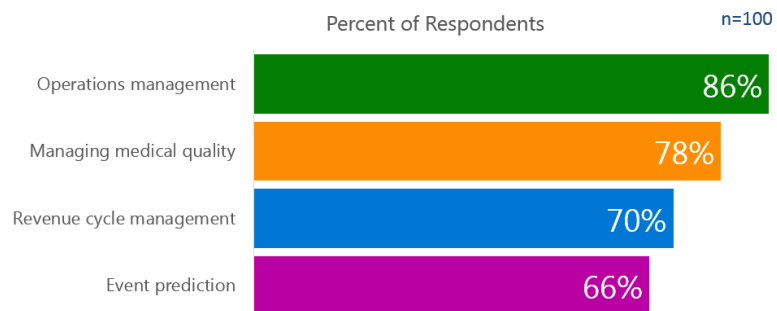
Data science has been used by organizations for decades. What has changed are accessibility and cost structure. With Cortana Analytics, the building blocks for data science projects are already in place. There is no longer a need to build costly data centers. Microsoft has already built these assets and customers are charged based on their usage.

For healthcare organizations, the implications are profound. Medical professionals are in the business of healing patients. With the mechanics of data science taken care of by Microsoft, these professionals can focus on programs that improve patient outcomes, reduce costs, and lay a foundation for the sweeping changes to the healthcare system that will occur over the next decade.

Harnessing the power of advanced analytics

Advanced analytics can quickly turn data into business opportunities and competitive advantage. Some 59 percent of the healthcare executives Microsoft surveyed said they are already gaining competitive advantage by using analytics for management of operations, medical quality and outcomes, revenue cycles, and prediction/prevention of costly hospital readmissions. In the graphic below, respondents were asked to list all uses of analytics. Predicting future events is applicable to reducing patient readmissions and developing an effective population health program.

Current Uses of Analytics in Healthcare

Percent of Respondents   n=100

Operations management	86%
Managing medical quality	78%
Revenue cycle management	70%
Event prediction	66%

International Data Corporation (IDC) foresees a $109 billion opportunity for healthcare organizations worldwide from data and analytics investment over the next four years. The breakdown is as follows:

- $63 billion from reduced costs
- $27 billion from increased revenue
- $19 billion from improved productivity[4]

Of course, more than access to data is needed to make wise clinical and business decisions. Success requires a data-driven culture that uses analytics in strategic ways to achieve goals. It's also necessary to create and adopt methodologies that use a unified model of analyzing data in an integrated way across all settings.

In the future, high-quality treatment plans will rely on more than clinical data from electronic health records (EHRs) and diagnostic images. Data will be compiled and analyzed with environmental and socioeconomic information, and/or compared with genomics. The goal is to generate highly personalized treatment plans based on a foundation of relevant, reliable data.

Managing healthcare across populations must include comparisons of individual patients with the entire class of patients having similar, especially chronic, conditions. Then, improving healthcare for the individual will result in benefits for the whole healthcare system.

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[4] Cynthia Burghard and Dan Vesset, Capture the $109 Billion Data Dividend in the Healthcare Industry, IDC. April 2015.

Using the expanding world of real-time data to predict adverse health events in near-real time can lead to prevention and improved treatment. With analytics, there's no need to wait until a patient is diagnosed. By integrating traditional data sources such as family history with genomics, patterns can be seen early. Healthcare providers can then intervene in timely ways to ameliorate debilitated conditions.

Analyzing patient outcomes and population health trends can reveal new workflows and approaches to care delivery, optimizing hospital processes. That could well lead to increased staff efficiency, productivity, and satisfaction, which can ultimately result in lower turnover and a better bottom line.

It is estimated that as much as $125 billion is lost each year through poor billing practices.[5] Analytics can provide insight into billing problems, such as payments not correlating to electronic patient statements. It can help healthcare organizations identify and avoid fraud, waste, and abuse.

Finally, as healthcare is becoming more integrated into daily life, potential patients expect to shop and compare healthcare costs/services, just as they do other online purchases. Organizations that use advanced analytics and the cloud can more easily provide the current, accurate information patients seek.
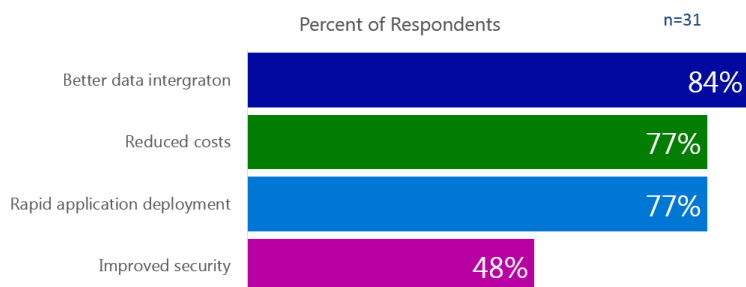
Cloud Advantages

Why cloud computing makes sense for Healthcare

Today, the cloud is cheaper, faster, more capacious and more secure than earlier technologies, about one third of the respondents have reported that the cloud generates a competitive advantage for healthcare organizations. The table below illustrates the primary value of the cloud for these respondents.

Sources of Cloud Competitive Advantage

Percent of Respondents   n=31

Better data intergraton	84%
Reduced costs	77%
Rapid application deployment	77%
Improved security	48%

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[5] Kelsey Brimmer, 5 Ways Hospitals Can Use data Analytics: Reduce Costs, Improve Care Coordination, Healthcare Finance News, 28 Feb 2013.

The cloud supports a wide range of uses, from modeling patient risk factors for hospital readmission to analyzing disparate data from across an entire organization. Those who use the cloud and analytics can optimize workflows, resources, and care differences. Cloud-users can have flexible and rapid application development. Throughout, the cloud maintains the security of sensitive data.

Microsoft understands that security, privacy, compliance, and transparency are essential to any cloud solution. For more information about the Microsoft commitment to these mandates see the document, "Trustworthy Cloud Computing."

Making breakthroughs with the cloud

By using the Microsoft cloud and advanced analytics, medical researchers are now able to work with larger databases than was practical with previous technologies. As a result, a number of longtime medical mysteries may be solved in far less time.

The Wellcome Trust in Cambridge, England is researching the genetic causes of seven diseases: bipolar disorder, coronary artery disease, hypertension, Crohn's Disease, rheumatoid arthritis and diabetes, Types I and II. It has used the massive storage and powerful computing capacity of the cloud to manage genetic information from 2,000 people while managing a shared set of approximately 13,000 controls for each of the seven diseases. With the cloud, the Wellcome Trust can complete 1 million tasks in 72 hours, equal to approximately 1.9 million computing hours. Had the same process been run on a typical on-premises system, the computation would have taken 25 years.

The Wellcome Trust has been able to analyze more than 63 billion pairs of genetic markers. The new associations they are finding between the genome and the seven targeted diseases could well lead to breakthroughs in prevention and treatment.

A smaller-scale example showcases how the cloud and analytics are being used to improve elder care. Care Innovations is a GE and Intel company that uses advanced analytics and sensor data to non-intrusively monitor seniors living at home or in assisted-living situations. Medical practitioners then analyze this data to create personalized treatment plans.

Care Innovations executives estimate that by using the cloud and analytics instead of older technologies they're able to cut costs in half. At the same time, patients' lives are improved. Remote monitoring, for example, can reveal whether a patient is following the treatment protocol correctly. Intervening to make necessary corrections can have great value for the patient and those who pay for the patient's care.

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Healthcare Scenarios with Big Data

An analytics solution can accelerate the changes healthcare organizations need today to succeed.

Operational efficiency

Operational efficiency includes hundreds of elements focused on patient care and treatment outcomes. These range from human resources and managing the supply chain to optimizing workflow and forecasting staff and/or patient needs. To make informed business decisions, management must understand the factors that affect operational efficiency. This scenario presents three elements of operational efficiency:

- reduction of hospital readmissions
- prevention of healthcare-acquired infections
- improvement of patient census forecasting.

New regulations increasingly penalize hospitals for insufficient progress in the reduction of healthcare-acquired infections and in hospital readmissions. In 2014 Medicare fined 2,810 hospitals $428 million for having high hospital readmission rates.[6]

Curtailing Hospital Readmissions

In the U.S., preventable hospital readmissions account for an estimated $25 billion a year of wasted hospital spending. Among the chronic conditions most often associated with the highest rates of readmission are heart failure, myocardial infarction, stroke and chronic obstructive pulmonary disease.

There are a number of possible reasons for a readmission, including little or no access to quality care in the community, inadequate discharge instructions or poor understanding of those instructions, lack of coordination or follow-up with the primary care physician or others involved in post-discharge care, complications from medical errors, or problems stemming from the initial hospital stay.[7]

Carolinas Healthcare System (CHCS), a publicly run non-profit system in Charlotte, N.C., has worked with Microsoft and thus provides a model for how analytics can solve the problem.

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[6] Jordan Rau, 2,610 Hospitals Fined for Readmissions, Healthcare IT News, 9 October 9 2014.
[7] Preventing Hospital Readmissions: A $25 Billion Opportunity," National Priorities Partnership, November 2010.

After analyzing 18 months of patient care, CHCS identified some 600 variables that could be used to discern patients most likely to be readmitted within 30 days. Of the 600 variables, they isolated 40 that were highly predictive of readmission. The culprits include language barriers, end-stage renal disease, inappropriate sodium levels, and a history of emergency room visits.[8]

Using data from 200,000 patient-discharge records, CHCS arrived at a model. It called for evaluating each patient hourly throughout the hospital stay. Patients can be grouped as high risk, mid-level risk or no risk. The data from hourly evaluations indicate when a patient's changed circumstance might alter the risk of readmission.

With analytics at the bedside, clinicians gain insight in real time that helps them improve patient care and customize discharge planning. CHCS has used readmission risk data to intervene in 125,000 cases. Accordingly, they avoided costly penalties that could have run in the hundreds of thousands of dollars. [9]

The predictive data model not only prevents avoidable hospital readmissions; it identifies patterns with certain chronic diseases. Spotting the pattern makes early intervention possible and that could keep patients out of the hospital in the first place.

Analytics at the bedside does not just improve patient care; it helps deliver a positive patient experience. And that mitigates the hospital's risk and expense. As CHCS has demonstrated, when clinicians have insight into Big Data in real time, patient care can be improved and lives can be saved.

Preventing healthcare-acquired infections

Another key part of operational efficiency is prevention of healthcare-acquired infections. They can be life threatening, they're expensive to treat and they're often preventable. Eliminating healthcare-acquired infections is vital to patient health as well as to a healthcare facility's bottom line.

Healthcare-acquired infections affect 1 in 20 patients, at a cost to hospitals of about $10 billion per year.[10] In the first few months of 2015, Medicare penalized 724 hospitals some $330 million for having extra-high rates of healthcare-acquired conditions.[11]

> After analyzing 18 months of patient care, CHCS identified some 600 variables that could be used to identify patients most likely to be readmitted within 30 days.

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[8] Modern Healthcare, 7 December 2013.
[9] Jordan Rau, 2,610 Hospitals Fined for Readmissions, Healthcare IT News, 9 October 2014.
[10] Brenda Goodman, Hospital-Acquired Infections Cost $10 Billion a Year: Study, Health.com, 2013.
[11] Maureen McKinney, Modern Healthcare, 18 December 2014.

CHCS has demonstrated a model to catch errors and prevent patient harm. It analyzed patient data as well as the occurrence, location, sanitation practices, and other variables of healthcare-acquired infections. It then instituted practices and procedures to mitigate the problem. In one year CHCS prevented an estimated 4,400 events in the categories of healthcare-acquired infections, hospital readmission rates and adverse drug reactions. CHCS executives estimate the savings in one year at more than $17 million.[12]

Forecasting hospital bed occupancy

Operational efficiency also requires accurate patient census forecasting. Hospitals need to ensure that sufficient numbers of beds are available in the community and that those beds are seldom empty. The number of available beds affects staffing levels, surgery schedules, admissions from the emergency room, and more.

With real-time information gathered from multiple settings and activities, advanced analytics can help hospitals:

- identify process bottlenecks and make changes that benefit patients and possibly an overworked staff
- reduce delays by synchronizing workflows among the various services
- forecast demand for limited resources
- maintain flexible occupancy by balancing elective procedures with acute needs
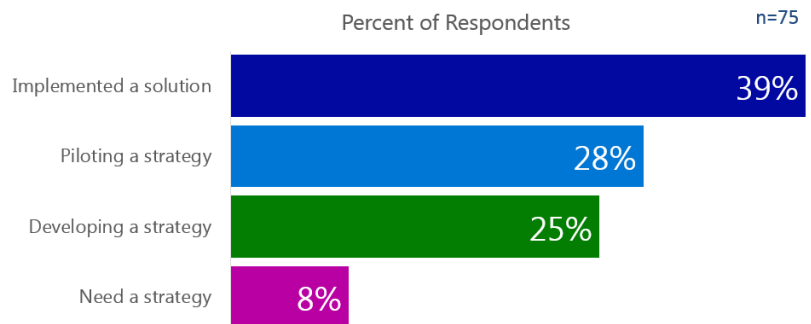
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[12] Katie Sullivan, Carolinas HealthCare saves $17M, reduces HAIs, readmissions, Fierce Healthcare, 22 May 2014.

Implementing Population Health

As healthcare shifts to an outcome-based model, population health becomes a key priority. Population health is an initiative whereby caregivers will be paid based on the health of the overall population for which they've been given responsibility. It's another shift: away from reactive treatment and towards prevention. Less expensive than reactive medicine, prevention also improves the patient's quality of life.

Yet a Microsoft survey revealed that only 25 percent of providers were even familiar with the term, population health. A recent survey by Healthcare Information and Management System Society showed that only one-third of U.S. hospitals are IT-ready for the enormous quantities of data and analytics required by population health.[13] That echoes another Microsoft survey showing that only 39 percent of hospitals have implemented a population health strategy. Eight percent have no strategy in place. The table below is based on the 75 respondents who were familiar with the term, population health.

Population Health Strategy

Percent of Respondents   n=75

Implemented a solution	39%
Piloting a strategy	28%
Developing a strategy	25%
Need a strategy	8%

Advanced analytics will play a major role in implementing the population health initiative. Caregivers will need to understand all aspects of their assigned population, from diet, exercise patterns, exposure to or participation in violent crime to environmental quality, genetic predispositions, and more. With this information, organizations can create proactive strategies for improving overall health.

Compensation will be based on the subject population's health. The goal is to keep the population as healthy as possible at the lowest possible cost. Success in this endeavor will generate profits and shareholder satisfaction.

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[13] Bruce Japsen, Just One-Third of Hospitals IT-Ready For Population Health, Forbes, 13 April 2015.

An innovative approach to patient care

A comprehensive population health solution will require many different analytics systems tied together into a single program. Subsystems based on sensors and social networking will play a role in the overall solution. An example of such a subsystem is an application developed by Dartmouth-Hitchcock.

Dartmouth-Hitchcock, a healthcare network in New England associated with Dartmouth University, is using an innovative approach to improve care. In October 2015, it will pilot a remote monitoring system for 6,000 patients requiring chronic care. The data from these sensors will be stored in the Microsoft cloud and evaluated with advanced analytics. The information gleaned from analytics will provide valuable insights for each caregiver that is involved in patient care.

The Dartmouth-Hitchcock approach is founded on collaboration. Patients and their families remain deeply involved in decision-making. Providers partner with other health systems, streamlining communication and telemedicine so that rural and historically underserved communities have good access to healthcare.

Dartmouth-Hitchcock has built a proactive system that focuses on customer service, a system that delivers "always-on" healthcare with a cloud-based system. Nurses and health coaches track and respond to an individual's health status in real time. Data from sensors and such devices as blood-pressure cuffs are transmitted by smartphone to the cloud. The data then appears on a contact center dashboard monitored around the clock by registered nurses. When a person's data exceed the personally prescribed threshold, the nurse is alerted. He or she then reaches out to the patient by phone, video chat, or secure text, often before the patient even knows there is a problem.

Taking advantage of advanced analytics, the ImagineCare solution can significantly enhance patient outcomes. It can even predict such catastrophic events as heart attacks.

Big Data, advanced analytics, and machine learning work together continuously to improve care, one patient at a time.

Conclusion

The healthcare industry in America is rapidly changing. The competitive edge will go to those organizations that implement new ways to meet changing regulations and patient expectations, while harnessing the proliferation and interoperability of enormous, complex data sets. Clearly, data plus advanced analytics is the future of healthcare.

Having access to better patient data can lead to better patient care and improved outcomes, while increasing efficiency and saving time and money. Microsoft's cloud infrastructure supported by the Cortana Analytics Suite can help improve patient services in the home, the clinic, and the hospital. It can also provide tools to help prevent certain infections and diseases, increase collaborative care, improve the management of chronic conditions, and find operational efficiencies.

By taking advantage of Microsoft's cloud infrastructure, healthcare organizations can create a system that meets today's needs and delivers on the promise of population health in the future.